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A61J 3/07

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B8C A

(56) Documents cited

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GB 0818365	EP A1 0116743
EP A1 0129445	EP A2 0110603
EP A2 0127105	EP A1 0110500

(58) Field of search
B8C
Selected US specifications from IPC sub-class A61J

(54) Process for filling and sealing a vessel

(57) A process for filling and sealing a vessel which is formed of starch or at least one other hydrophilic material, or a mixture of compounds of this nature, and which comprises a container part and a closure part, the container part and closure part being capable of cooperating along respective mating areas to provide a non-locking mating free of any snap-lock, comprising:

(a) introducing a product constituting the filling into the container part of the vessel;

(b) bringing a sealing liquid into contact with the whole or a portion of that mating area of the closure part which touches the mating area of the container part when the vessel is in the closed state, and/or with the whole or a portion of that mating area of the container part which touches the mating area of the closure part when the vessel is in the closed state; and

(c) subsequently uniting the container part and the closure part in order to form the sealed vessel.

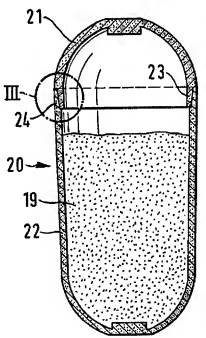

Fig. 2

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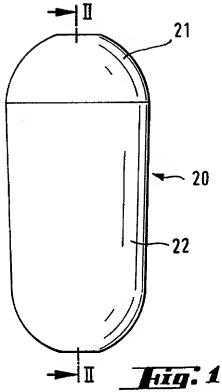

Fig. 1

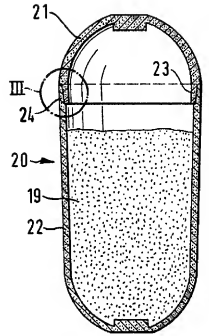

Fig. 2

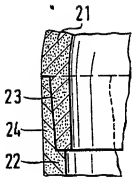

Fig. 3a

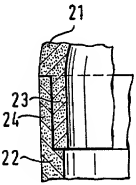

Fig. 3b

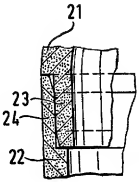

Fig. 3c

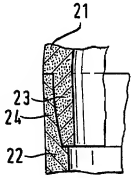

Fig. 3d

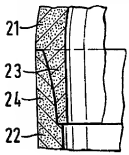

Fig. 3e

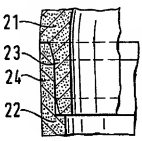

Fig. 3f

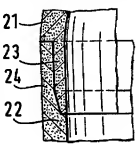

Fig. 3g

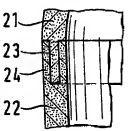

Fig. 3h

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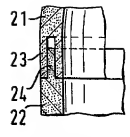

Fig. 3i

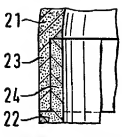

Fig. 3k

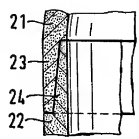

Fig. 3l

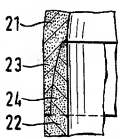

Fig. 3m

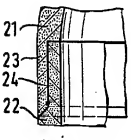

Fig. 3n

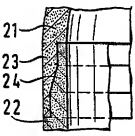

Fig. 3o

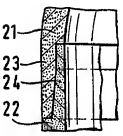

Fig. 3p

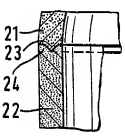

Fig. 3q

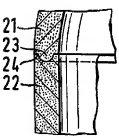

Fig. 3r

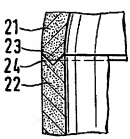

Fig. 3s

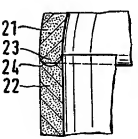

Fig. 3t

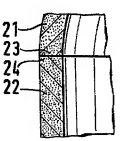

Fig. 3u

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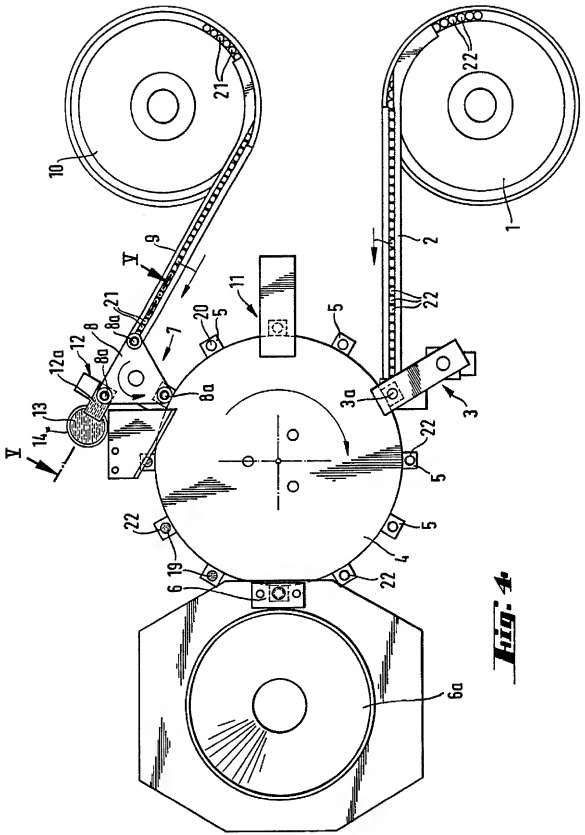

Fig. 4

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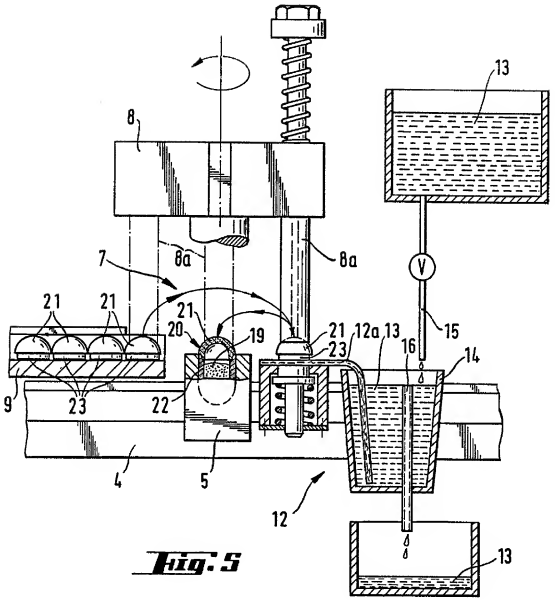

Fig. 5

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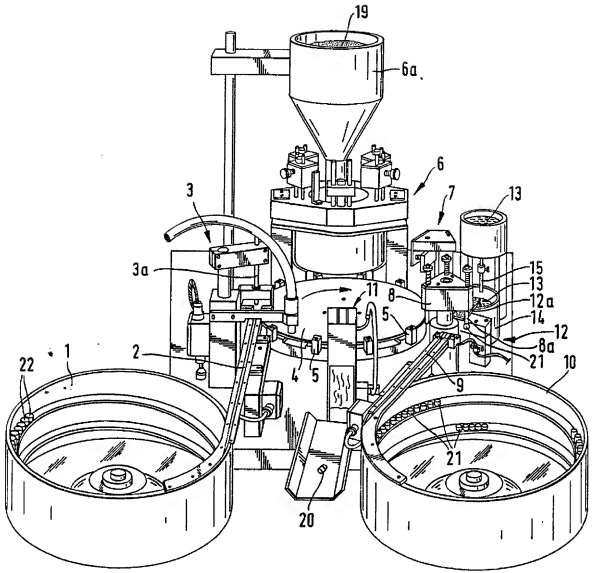

Fig. 6

SPECIFICATION

Process for filling and sealing a vessel

This invention relates to a process for filling and sealing vessels with a non-locking mating. It is known that injection molding technique can be used to produce pressure moldings from natural starch, or from hydrophilic materials such as, for example, gelatin. Vessels of this nature are produced because they are preferred vehicles for filling with pharmaceutical products, consumables, chemicals and the like, and they are, in particular, produced in the shape of pharmaceutical capsules for the dosed administration of medicines. These vessels comprise a container part and a closure part, at least one of the two parts, and often both parts are generally provided with mating ridges and grooves in such a way as to guarantee a snap effect, and thus to guarantee that a good closure is obtained between the two of them. Pharmaceutical capsules have relatively small dimensions. In cases involving the filling of the vessels with pharmaceutical agents, the snap effect is particularly important because it must prevent the vessel from being opened, either accidentally, or even if opening is deliberately attempted. According to the methods known at the present time, the snap closure is obtained by providing a very precise undercut in the container part, and/or in the closure part, such an undercut being approximately 0.03 to 0.15 mm deep. A smaller undercut results in a defective closure, while an excessively large one gives rise to cracking, especially in the container part.

Even if produced accurately, such snap-closures are subject to various disadvantages. The wall thickness of a pharmaceutical capsule must be kept as thin as possible. In consequence, the wall thickness of the container part will differ from that of the closure part. Because of their different thicknesses, these two parts will exhibit dissimilar dimensional behavior under non-steady-state conditions, and this will cause the two parts to become geometrically dissimilar, which will lead to the generation of stresses, especially when the atmospheric humidity is changing. Under some conditions, this can cause the vessel to rupture, and if they have been filled with powders or liquids their contents will then leak out. In particular, difficulties can also arise in the filling machine, especially during the operation of closing the two parts.

Moreover, such snap-closures are also technically complicated to produce. In particular, sliding, carriage-type molds or split-follower molds are necessary, and the moving mold parts leave markings which then appear as uneven areas on the surface of the molding. As a result of the need for sliding carriages or followers, the molds possess more sliding parts, suffer more wear, operate at higher pressures or with higher locking forces, as the case may be, and exhibit greater susceptibility to faults, which manifest themselves through longer downtimes and increased plant costs. Furthermore, sliding carriages destabilize the mold to a certain extent. In particular, fewer cavities can be installed per available area, and this considerably reduces the output.

It has now been found that all the abovementioned disadvantages can be eliminated when pressure-moulded parts with a non-locking mating are utilized, and when these parts are sealed in the manner according to the present invention, as will be described later in this disclosure. These parts preferably form a vessel with an essentially continuous outer surface.

According to one aspect of the present invention, there is provided a process for filling and sealing a vessel which is formed of starch or at least one other hydrophilic material, or a mixture of compounds of this nature, and which comprises a container part and a closure part, the container part and closure part being capable of cooperating along respective mating areas to provide a non-locking mating free of any snap-lock, the filling and sealing process comprising:

(a) introducing a product constituting the filling into the container part of the vessel;

(b) bringing a sealing liquid into contact with the whole or a portion of that mating area of the closure part which touches the mating area of the container part when the vessel is in the closed state, and/or with the whole or a portion of that mating area of the container part which touches the mating area of the closure part when the vessel is in the closed state; and

(c) subsequently uniting the container part and the closure part in order to form the sealed vessel.

Preferably the seal part and the closure part of the vessel are produced by pressure moulding.

Preferably the pressure moulding is accomplished by injection moulding.

Preferably the vessel is in the shape of a pharmaceutical capsule.

Preferably the starch is a carbohydrate of natural, vegetable origin, which is composed mainly of amylose and amlyopectin. Preferably it is extracted from various plants, examples being potatoes, rice, tapioca, corn and cereals such as rye, oats and wheat. By applying pressure and at the same time raising the temperature, starch of this nature can be formed into dense molded articles exhibiting a high degree of precision. The production technique for the pressure-molding operation, particularly for the injection-moulding operation which is performed under pressure and at an elevated temperature, is described in European Patent Application No. 84 300 940.8 (publ. No. 118 240), and also applies for the present invention, this published description specifying the process conditions and including information regarding the possible additives, such as extenders, lubricants, plasticizers and/or coloring agents and is hereby incorporated by reference (also preferred temperatures, pressure and moisture level contents).

The other hydrophilic material is any other hydrophilic material suitable for the production of the vessel, according to the present invention, and which are especially suitable for the production of vessels of the shape of pharmaceutical capsules.

Preferably the other hydrophilic material is selected from: gelatin; sunflower protein, soybean proteins, cotton seed proteins, peanut proteins, rape seed proteins, blood proteins, egg proteins, acrylated proteins and other vegetable proteins; alginates, carrageenans, guar gum, agar-agar, gum arabic and related gums (gum ghatti, gum karaya, gum tragacauth), pectin and other water-soluble polysaccharides; and any combination thereof.

Preferably the other hydrophilic material is selected from water-soluble derivatives of cellulose; alkylcelluloses, hydroxyalkylcelluloses and hydroxyalkylalkylcelluloses, including methylcellulose, hydroxymethylcellulose, hydroxyethylcellulose, hydroxypropylcellulose, hydroxyethylmethylcellulose, hydroxypropylmethylcellulose and hydroxybutylmethylcellulose; cellulose esters and hydroxyalkylcellulose esters including cellulose acetylphthalate (CAP), and hydroxypropylmethylcellulose phthalate (HPMCP); carboxyalkylcelluloses, carboxyalkylalkylcelluloses, and carboxyalkylcellulose esters including carboxymethylcellulose, and their alkali metal salts; water-soluble synthetic polymers including polyacrylic acids and polyacrylic acid esters, polymethacrylic acids and polymethacrylic acid esters, polyvinyl acetates, polyvinyl alcohols, polyvinyl acetate phthalates (PVAP), polyvinyl pyrrolidone, and polycrotonic acids; phthalated gelatin; gelatin succinate; crosslinked gelatin; shellac; water-soluble chemical derivatives of starch; and cationically modified acrylates and methacrylates possessing, for example, a tertiary or quaternary amino group, such as the diethyl-amino group, which may be quaternized if desired; and other similar polymers, and any combination thereof. Gelatin is preferred.

The production techniques of the pressure-molding of other hydrophilic materials, of the types just mentioned, and particularly for the injection-molding operation which is performed under pressure and at an elevated temperature, are described in European Patent Application No. 83 301 643.9 (Publ. No. 090 600), which specifies the process conditions and includes information regarding the possible additives, such as extenders, lubricants, plasticizers and/or coloring agents. This application is also incorporated by reference (incl. preferred temperatures, pressures and moisture level contents). Such hydrophilic materials are described e.g. in Robert L. Davidson, Handbook of Water-Soluble Gums and Resins, McGraw-Hill Book Company.

The details described in the two European Patent Applications cited above, Nos. 84 300 940.8 and 83 301 643.9, relating to the production of pressure-molded vessels of the type in question, and especially to the production of pressure-molded pharmaceutical capsules, preferably by injection molding, also apply in the case of the present invention and are part of this invention.

The present invention utilizes pressure-molded and preferably injection molded vessels which can be obtained in this way, these vessels preferably being of the shape pharmaceutical capsules.

It is within the scope of this invention to blend or combine the various hydrophilic materials listed. To the above mentioned materials may be added inorganic fillers, such as the oxides of magnesium, aluminum, silicon, titanium, etc. Extender concentrations of up to 50 % are indicated, but they should preferably range from 3 to 10 %, based on the weight of all the components forming the vessel wall.

Examples of plasticizers which may be added include polyalkylene oxides, such as polyethylene glycols, polypropylene glycols, polyethylene-propylene glycols; organic plasticizers with lower molecular weights, such as glycerol, glycerol monoacetate, diacetate or tricetate; propylene glycol, sorbitol, sodium diethylsulfosuccinate, triethyl citrate, tributyl citrate, etc., added in concentrations ranging from 0.5 to 15%, preferably ranging from 0.5 to 5% based on the weight of all the components.

Examples of coloring agents include known azo dyes, organic or inorganic pigments, or coloring agents of natural origin. Inorganic pigments are preferred, such as the oxides of iron or titanium, these oxides, known per se, being added in concentrations ranging from 0.001 to 10%, preferably 0.5 to 3%, based on the weight of all the components forming the vessel wall.

Preferably the container and closure parts of the vessel have a water content of from 10 to 20%, more preferably from 12 to 19%, and even more preferably from 14 to 18%, based on the weight of all the components forming those parts of the vessel.

The sum of the plasticizer and water contents of the container and closure parts of the vessel should preferably not exceed 25%, and should more preferably not exceed 20%, based on the weight of all the components forming those parts of the vessel.

While this invention is described with reference to capsule forms it is understood that the invention is meant to cover all containers which are essentially hollow, susceptible of being made from the hydrophilic materials mentioned above and form a disposable, sealed vessel. The vessel is further characterized as having preferably an essentially continuous outer surface.

In comparison with European Patent documents 84 300 940.8 (118 240) and 83 301 643.9 (090 600), the special feature of the vessels according to the present invention is that the closure part and the container part of the vessel exhibit no snap-lock ridges or grooves and also, in consequence of this, possess no snap-closure arrangements of any kind. The preferred type of vessel is one in which the container part and the closure part can be united without any deformation. Vessels of this type are novel, and are the subject of the present invention. After being closed, the vessels according to the present invention preferably possess virtually the same wall thickness overall, thus avoiding the generation of stresses as a result of dissimilar dimensional behaviour under non-steady-state conditions.

According to a further aspect of the present invention these is provided a vessel which has been produced by injection moulding of natural starch or at least one other hydrophilic material, or a mixture of compounds of this nature, the vessel being a pharmaceutical capsule comprising a container part and a closure part

which can be united with a non-locking mating and without any significant deformation, for use in a process according to any previously mentioned aspect of the present invention.

According to a still further aspect of the present invention these is provided an appliance for filling and closing pressure-moulded container and closure parts in order to form pharmaceutical capsules, the appliance comprising a container part magazine (1), a conveying channel (2) which connects the magazine (1) to a container part feed station (3), a device (3a) for securing the container parts in container part holders (5) which are fixedly installed on a rotary table (4), a filling station (6), a closure part magazine (10), a conveying channel (9) which feeds the closure parts to closure part holders (a), a sealing station (12) a closure station (7) and an ejection station (11) downstream of the closure station (7).

Vessels according to the present invention are uncomplicated to produce, as well as being easy to fill and close. However, because no snap-closure is now provided, they can be opened easily, or they will open of their own accord during subsequent handling, especially as the container part and closure part are mated without any deformation, even if this mating operation is performed in a highly precise manner. The area elements which are pushed together, one inside the other, are generally only 0.5 to 2 mm higher, the latter value being a maximum.

Accordingly, it was surprising to discover that the containers do not open if a sealing liquid is brought into contact with at least one of those areas of the container part and/or closure part which touch one another, thus permitting high speed filling; this operation being performed before the capsules are irrevocably closed.

This sealing liquid preferably contains water. This liquid is preferably a mixture of water and an alcohol, preferably the alcohol has from 1 to 4 carbon atoms, preferably ethanol, propyl alcohols or butyl alcohols, and particularly preferably ethanol or isopropyl alcohol, and most preferably ethanol, the water/alcohol ratio ranging from 95:5 to 40:60, but preferably ranging from 80:20 to 60:40, and most preferably being approximately 70:30.

Further aqueous sealing agents include, for example, aqueous solutions, in a concentration of from 0.5 to 10 percent by weight, and preferably from 1 to 4 percent by weight, based on the total weight of the sealing liquid, of sucrose, starch, monosaccharides, oligosaccharides and polysaccharides, glycerol and other polyols, glycol, polyethylene glycols and/or polypropylene glycols, surface-active agents which may be anionic, cationic or amphoteric, gelatin, polyvinyl alcohols, and water-soluble acrylic polymers which may be anionic or cationic.

The abovementioned water-ethanol mixture is preferred.

On its own, water, for example, gives rise to excessive wetting, or to wetting which is imprecisely distributed, and this causes damage to the capsule, or degradation of its contents. Because the outer capsule wall is sensitive to water, the sealing liquid must permit the wetting to be subject to precise control, with regard both to its positioning and to the quantity of liquid applied.

A certain time must, of course, elapse before a sealing effect begins to occur. This being so, it was surprising to discover that the closed vessels according to the invention can be subjected to further processing, and to packaging, without the occurrence of any phenomena which would indicate that they are opening or being damaged.

As a result of the precisely controlled manner in which the sealing liquid is applied, with regard both to its positioning and to the quantity which is fed out, an accurately closed vessel is obtained, which is impervious to liquids. Once sealed, the vessel can be opened only by destroying it.

In order to accelerate the sealing process it is preferable to heat the closed vessel in the region around the two mating areas. Any heat source which does not damage that vessel or its contents may be utilized, preferred examples of such sources including heat which is applied by convection, such as by means of heated air; electromagnetic radiation at a suitable frequency, such as microwaves or infrared radiation; and ultrasonic energy, the temperature thus generated being non-critical provided that no damage is caused to the capsule or its contents. However, there is normally no need to accelerate the sealing process by resorting to additional measures of this kind. Heating to 30 to 50°C generally suffices. Heating can also occur in whole or in part by the use of sealing fluid maintained at a temperature between 30°C and 100°C.

The product constituting the filling can be solid, pasty, or liquid. The substances which are dispensed in pharmaceutical vessels are here substances which are compatible with the vessel wall, and which are conventionally dispensed in hard gelatin pharmaceutical vessels.

In addition to eliminating the disadvantages mentioned in the introductory paragraphs, further advantages which were not expected, follow from the utilization of the vessel according to the present invention, and from the manner in which they are sealed. It is thus feasible to reduce the vessel wall thickness by a large amount, since the mechanical stresses generated by the snap closure have been eliminated. This results in a significant decrease in the time which the vessel takes to open and dissolve in the gastric or intestinal juices, as well as in a saving of material and improved utilization of the vessel volume.

For a better understanding of the present invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 shows a vessel according to the invention, in side view,

Figure 2 shows a vessel according to the invention, in longitudinal section along the line II-II in Figure 1,

Figures 3a - 3u show cross sectional views of various embodiments of the stressfree joint of the container part to the closure part, corresponding to the indication 18 in Figure 2,

Figure 4 shows a plan view of a filling/sealing machine for the vessels according to the invention.

Figure 5 shows the wetting and sealing station which is associated with the filling/sealing machine, this station being represented in section along the line V-V in Figure 4, and

Figure 6 shows a perspective illustration of a filling machine, namely a machine of the design shown in Figure 4, equipped with a wetting station.

A vessel 20 having a container 22 and a closure part 21 with a powdered fill component 19 is shown after sealing having the stress free configuration represented in *Figures 1 and 2*. As can be seen, an essentially continuous surface is formed on the outer surface of the capsule after the container mating portion 24 is positioned adjacent seal mating portion 23. *Figures 3a - 3u* show differing configurations of the mating unit 18. In each of these figures, it can be seen that a smooth essentially continuous outer surface of the vessel 20 is formed at the area 18 of the mating unit. *Figure 4* shows the design of a filling machine in horizontal cross-section, this machine being equipped with a sealing station. In this machine, the magazine 1 is connected to a continously vibrating conveying channel, 2, which guides the container parts to the container part feed station 3.

In this container part feed station 3, the container parts, with their openings facing upwards, are pressed into the container part holders 5 by means of the ram 3a. The container part holders 5 are fixedly installed on the rotary table 4. The container parts are now conveyed to the filling station 6, in a sequence of timed steps which are defined by the stepping rotation of the rotary table, in which filling station each container part receives a metered quantity of a powder 19, or of a paste or liquid, the product in question being supplied from a stock container 6a.

The container part, thus filled, then moves to the closing station 7, likewise in successive, timed steps. In this closing station 7, the closure parts, fed in from the closure part magazine 10 by means of vibration, via the conveying channel 9, are transferred onto a piece of felt 12a, which wets them, and are then placed on the container parts, these operations being effected by means of the star rotor 8 and the closure part holder 8a. After being conveyed further, likewise in successive, timed steps, the closed vessel – shaped like pharmaceutical capsule in the present case – is ejected from the container part holder 5 on arrival at the ejection station 11. *Figure 5* shows a sealing station 12 in horizontal cross-section. The closure parts 21 are located within the conveying channel 9, whence they are acquired by the closure part holder 8a, this being effected by means of a vacuum, after which they are transferred to the sealing station 12 with a positioning and wetting unit, as a result of a combined rotational and vertical movement. Vertical movement of the closure part holder 8a causes the closure part 21 to be pressed onto the felt 12a, which is impregnated with sealing liquid 13.

At the same time, the closure part 21 is aligned, and its overlap zone is wetted with sealing liquid. The sealing liquid is supplied from the container 14, and is drawn into the felt 12a by capillarity, the liquid level in the container 14 being kept constant by means of a dropper 15 and an overflow 16. Subsequent rotation of the closure part holder 8a, combined with a vertical movement, brings the closure part 21 to the seal station 7, in which it is pressed onto the container part 22 as a result of a vertical movement of the closure part holder 8a. Of course, any other suitable wetting technique can be used.

At the same time, the vacuum is removed – this vacuum having been holding the closure part 21 in the closure part holder 8a. The closure part holder 8a now executes a combined rotational and vertical movement which advances it to the vibrating channel 9, in order to acquire a fresh closure part 21.

Both the closing machine, as described, and the sealing station are novel, and each forms part of the invention. Whereas hard gelatin pharmaceutical capsules are conventionally pre-closed before being supplied to the closing machine, the invention enables the closure part 21 and the container part 22 to be loaded in separate magazines, 10 and 1, and to be conveyed to the closing station 7 independently of one another. It is thus possible, in addition, to wet the parts independently, prior to the closing operation.

The invention is illustrated by the following Examples:

Example 1

The lip (mating part according to Figure 3a) of the closure part (21) of a vessel having the shape shown in Figure 1 was pressed onto a piece of fine felt, to a depth of 1.5 mm, this felt having been impregnated with a sealing liquid containing 70 % by volume of water and 30 % by volume of ethanol, so that the thin lip of this closure part was completely wetted, the vessel in question having been injection-molded from natural wheat starch according to the conditions specified in EP document 84 300 940.8 (118 240), Example 8 (water content: 12.7%). This closure part was thereafter united with the container part, which fitted it, no stresses being generated as a result of this closing operation.

After 10 minutes, the vessel could no longer be opened. The same result was obtained when the vessel had previously been filled with solid, pasty or liquid pharmaceutical compositions, sealed vessels did not leak.

Example 2

The procedure described in the context of Example 1 was repeated, but with the addition of an operation wherein the vessel was exposed, without delay, to one of the following heat sources:

(i) air which had been heated to 35°C: 3 minutes,
(ii) infrared radiation: 2 1/2 minutes,
(iii) ultrasonic energy: 2 seconds.

Thereafter, the vessel could no longer be opened, and were impervious to liquids.

Example 3

The lip (according to Figure 3 1) of the closure part (21) of a gelatin capsule having the shape shown in the Figure 1 relating to the present invention was placed on a plate carrying a film of liquid, 1.0 mm deep, this liquid being an 80:20 mixture of water and ethanol, while the capsule itself had been produced in accordance with the conditions specified in EP document 83 301 643.9 (090 600), Example 2 B-2 (water content 14.6%). The closure part was thereafter united with the container part, no deformation occuring during this closing operation.

After a 15-minute holding period, at room temperature, the vessel could no longer be opened. When, thereafter, one of the heat sources mentioned in the context of Example 2 was utilized, the shorter welding times cited therein were obtained.

In no case could the vessel be opened after completion of the sealing process, without destroying it at the same time.

Example 4

The procedures described in the context of Example 1, 2 and 3 were repeated, employing sealing liquids of the following compositions:

No.	Water %	Ethanol %	Other additions
1	95	5	-
2	85	15	-
3	60	40	-
4	50	50	-
5	98	-	SLS* 2%
6	98	-	Glucose 1%, SLS 1%
7	89	10	SLS 1%
8	60	38	SLS 2%
9	70	20	Glucose 5%, SLS 5%
10	80	16	Glycerol 4%

*SLS = sodium lauryl sulfate

CLAIMS

1. A process for filling and sealing a vessel which is formed of starch or at least one other hydrophilic material, or a mixture of compounds of this nature, and which comprises a container part and a closure part, the container part and closure part being capable of cooperating along respective mating areas to provide a non-locking mating free of any snap-lock, the filling and sealing process comprising:
(a) introducing a product constituting the filling into the container part of the vessel;
(b) bringing a sealing liquid into contact with the whole or a portion of that mating area of the closure part which touches the mating area of the container part when the vessel is in the closed state, and/or with the whole or a portion of that mating area of the container part which touches the mating area of the closure part when the vessel is in the closed state; and
(c) subsequently uniting the container part and the closure part in order to form the sealed vessel.

2. A process according to claim 1, wherein the seal part and the closure part of the vessel are produced by pressure moulding.

3. A process according to claim 2, wherein the pressure moulding is accomplished by injection moulding.

4. A process according to any preceding claim, wherein the vessel is in the shape of a pharmaceutical capsule.

5. A process according to any preceding claims, wherein the starch is a carbohydrate of natural, vegetable origin, which is composed mainly of amylose and amylopectin.

6. A process to any preceding claim, wherein the starch is one which has been extracted from one or more of: potatoes, rice, tapioca, corn, rye, oats, and wheat.

7. A process according to any preceding claim, wherein the other hydrophilic material is selected from: gelatin; sunflower protein, soybean proteins, cotton seed proteins, peanut proteins, rape seed proteins, blood proteins, egg proteins, acrylated proteins and other vegetable proteins; alginates, carrageenans, guar

gum, agar-agar, gum arabic and related gums (gum ghatti, gum karaya, gum tragacauth), pectin and other water-soluble polysaccharides; and any combination thereof.

8. A process according to any of claims 1 to 6, wherein the other hydrophilic material is selected from water-soluble derivatives of cellulose; alkylcelluloses, hydroxyalkylcelluloses and hydroxyalkylalkylcelluloses, including methylcellulose, hydroxymethylcellulose, hydroxyethylcellulose, hydroxypropylcellulose, hydroxyethylmethylcellulose, hydroxypropylmethylcellulose and hydroxybutylmethylcellulose; cellulose esters and hydroxyalkylcellulose esters including cellulose acetylphthalate (CAP), and hydroxypropylmethylcellulose phthalate (HPMCP); carboxyalkylcelluloses, carboxyalkylalkylcelluloses, and carboxyalkylcellulose esters including carboxymethylcellulose, and their alkali metal salts; water-soluble synthetic polymers including polyacrylic acids and polyacrylic acid esters, polymethacrylic acids and polymethacrylic acid esters, polyvinyl acetates, polyvinyl alcohols, polyvinyl acetate phthalates (PVAP), polyvinyl pyrrolidone, and polycrotonic acids; phthalated gelatin; gelatin succinate; crosslinked gelatin; shellac; water-soluble chemical derivatives of starch; and cationically modified acrylates and methacrylates and any combination thereof. Gelatin is preferred.

9. A process according to any preceding claim, wherein the container part and/or closure part of the vessel is/are formed of a composition which includes, in addition to the starch or other hydrophilic material, one or more of: extenders, plasticizers and/or colouring agents.

10. A process according to any preceding claim, wherein the container and closure parts of the vessel have a water content in the range from 10% to 20% based on the weight of all the components orming those parts of the vessel.

11. A process according to any preceding claim, wherein the container and closure parts of the vessel have a water content in the range from 12% to 19%, based on the weight of all the components forming those parts of the vessel.

12. A process according to any preceding claim, wherein the container and closure parts of the vessel have a water content in the range from 14% to 18% based on the weight of all the components forming those parts of the vessel.

13. A process according to any preceding claim, wherein the container part and the closure part can be united without any deformation.

14. A process according to any preceding claim wherein the sealing liquid is selected from aqueous solutions, in a concentration in the range from 0.5 to 10 percent by weight based on the total weight of the sealing liquid, of: sucrose, starch, monosaccharides, oligosaccharides, polysaccharides, glycerol, other polyols, glycol, polyethylene glycols, polypropylene glycols, surface-active agents which may be anionic, cationic or amphoteric, gelatin, polyvinyl alcohols, and water-soluble acrylic polymers which may be anionic or cationic.

15. A process according to claim 14, wherein the component, other than water, of the sealing liquid is present in a concentration of from 1 % to 4 % by weight, based on the total weight of the sealing liquid.

16. A process according to any of claims 1 to 13, wherein the sealing liquid is a mixture of water and an alcohol, the water:alcohol ratio being in the range from 95:5 to 40:60.

17. A process according to claim 16, wherein the water:alcohol ratio is in the range from 80:20 to 60:40.

18. A process according to claim 16, wherein the water:alcohol ratio is approximately 70:30.

19. A process according to any one of claims 16, 17 or 18, wherein the alcohol has from 1 to 4 carbon atoms.

20. A process according to claim 19, wherein the alcohol is ethanol, a propyl alchohol or a butyl alcohol.

21. A process according to claim 19 or 20, wherein the alcohol is ethanol or isopropyl alcohol.

22. A process according to claim 19, 20 or 21, wherein the alcohol is ethanol.

23. A process according to any preceding claim, wherein the region around the two mating areas is heated, after the container and closure parts have been united, by means of heat which is applied by convection, or by means of electromagnetic radiation at a suitable frequency, or by means of ultrasonic energy.

24. A process according to claim 23, wherein the electromagnetic radiation is microwave or infrared radiation.

25. A process according to any preceding claim, wherein the product constituting the filling is solid, pasty, or liquid.

26. A process according to claim 1, substantially as hereinbefore described.

27. A sealed vessel which is obtained according to the process of any of claims 1 to 26.

28. A vessel which has been produced by injection moulding of natural starch or at least one other hydrophilic material, or a mixture of compounds of this nature, the vessel being a pharmaceutical capsule comprising a container part and a closure part which can be united with a non-locking mating and without any significant deformation, for use in a process according to any of claims 1 to 26.

29. A vessel substantially as hereinbefore described, with reference to, and as shown in Figures 1 and 2, or any one of Figures 3a to 3u, of the accompanying drawings.

30. An appliance for filling and closing pressure-moulded container and closure parts in order to form pharmaceutical capsules, the appliance comprising a container part magazine (1), a conveying channel (2) which connects the magazine (1) to a container part feed station (3), a device (3a) for securing the container parts in container part holders (5) which are fixedly installed on a rotary table (4), a filling station (6), a closure part magazine (10), a conveying channel (9) which feeds the closure parts to closure part holders (8a), a

sealing station (12), a closure station (7), and an ejection station (11) downstream of the closure station (7).

31. An appliance substantially as hereinbefore described, with reference to, and as shown in, Figures 4 to 6 of the accompanying drawings.

Amendments to the claims have been filed, and have the following effect:–

(a) Claims 1 and 2 above have been deleted or textually amended.
(b) New or textually amended claims have been filed as follows:–
(c) Claims 3 to 31 above have been re-numbered as 2 to 30 and their appendancies corrected.

CLAIMS

1. A process for filling and sealing a vessel which is formed by pressure moulding of starch or at least one other hydrophilic material, or a mixture of compounds of this nature, and which comprises a container part and a closure part, the container part and closure part being capable of cooperating along respective mating areas to provide a non-locking mating free of any snap-lock, the nature of the mating areas being such that, when the vessel is in the closed state with the areas mating but in the absence of a sealing liquid, the container and closure parts can be freely moved apart to open the vessel, the filling and sealing process comprising:

(a) introducing a product constituting the filling into the container part of the vessel;

(b) bringing a sealing liquid into contact with the whole or a portion of that mating area of the closure part which touches the mating area of the container part when the vessel is in the closed state, and/or with the whole or a portion of that mating area of the container part which touches the mating area of the closure part when the vessel is in the closed state; and

(c) subsequently uniting the container part and the closure part in order to form the sealed vessel.

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